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DEVELOPMENT OF WATER AND SEWAGE INFRASTRUCTURE ON RURAL AREAS IN POLAND

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Abstract

The aim of this paper was to analyse development of a water and sewage infrastructure on rural areas in Poland. The study encompassed years 1989-2013 from which two periods have been distincted namely before (1989-2004) and after (2004-2013) the Poland accession to the European Union (EU). A significant increase in the length of waterworks (from 53.6 M to 223.4 M km) and sewage system (from 2.9 M to over 75 M km). Despite significantly faster extension of sewer system in examined period, a disadvantageous disproportion between its waterworks length has been indicated. The development of analyzed infrastructure has been accompanied by an improvement in terms of its quality and efficiency. Among others over 400 new waste-water treatment plants capable of removing biogenic contaminants. The population share served by waste-water treatment plants and waterworks has increased significantly (from 3.1 to 35.3%) and (from 61.4 to 76.6%). As a result an increase in terms of consumed water and sewage disposal has been claimed. Summing up it has been acknowledged that the development in water and sewage infrastructure on the rural areas in Poland lead to an increase in an investment attractiveness of those areas and the quality of its inhabitants lives.

Key words**:** *Poland, rural areas, sewage system, waterworks*

INTRODUCTION

From early 1990s population of rural areas has experienced a systematical growth. This phenomenon is mainly caused by a birth rate and a migration from urban to rural areas [10]. As a result the rural population share over the last dozen or so years has raised to 39.6% (from 38%). Despite a significant population living in rural areas over the years an evident underinvestment in terms of adequate technical infrastructure has been observed. Consequently the attractiveness of rural areas in respect of investments and housing was relatively low. It is important to note that one of the basic elements of a land management and planning, which is determinative when it comes to the: possibilities of economic initiative development; modernization of agricultural production; settlement development and environmental protection the adequate level of technical and water and sewage infrastructure is of vital importance [1].Therefore the development of water and sewage network in rural areas makes up to the most important factors of improving peoples living conditions. Hence the beginning of political transformation which took place at the turn of the 1980/90s the investments in mentioned areas are being realized. Additionally important factors which put pressure on rapid making good on deficiencies in said infrastructure are legal requirements for environmental protection imposed on Poland by the EU [10].
In this work an analysis of development in the range of water and sewage infrastructure on rural areas in Poland has been done. Research encompassed years 1989-2013 which have been divided into two periods, namely before (1989-2004) and after (2004-2013) accession to the EU.

MATERIALS AND METHODS

Data for this study have been obtained from: Local Data Bank of Central Statistical Office in Poland, Statistical Yearbooks of

Environmental Protection and Community Facilities. The assessment of water and sewage management development was based on the analysis of waterworks and sewers lengths changes and number and kind of wastewater treatment plants. The dynamics and pace of waterworks and sewers network changes have been assessed based on chain index of dynamics. By denoting the investigated phenomenon as y_i the mean chain index of dynamics given by equation:

$$\bar{i} = \sqrt[n-1]{\frac{y_1}{y_0} \cdot \frac{y_2}{y_1} \cdot \frac{y_3}{y_2} \cdot \ldots \cdot \frac{y_n}{y_{n-1}}} \qquad (1)$$

By applying the mean chain index of dynamics the average pace ($\overline{T}$) of waterworks and sewers length in analyzed time period has been calculated.

$$\overline{T} = (\bar{i} - 1) \cdot 100\ [\%] \qquad (2)$$

Presented analysis included also the number of individual wastewater treatments; septic tanks and population being served by both elements of communal infrastructure over the years 1989-2013.

RESULTS AND DISCUSSIONS

Over the period 1989-2013 a rapid development of water and sewage infrastructure on rural areas has been observed. The total length of sewers has increased from 2.9 M to over 75 M kilometers whereas waterworks length from 52.6 M to 233.4 M kilometers (Fig.1). Despite significantly greater percentage increase in the length of sewers than waterworks there still remains a huge disproportion between those two elements of infrastructure. However this difference has been extensively leveled as is indicated by the ratio of sewers to waterworks length in the year 1989 amounting to 1:18 and at the end of examined period only to 1:3. There are many causes underlying behind this state of affairs but to most important one may count among: lower costs of waterworks infrastructure and social considerations.
In the hierarchy of rural population needs for many years the development of water supplying infrastructure was higher than carrying impurities [9]. Significant changes occurred after an increase in population ecological awareness and the need to comply with EU environmental protection regulations [6]. Since the beginning of the 1990s the average annual pace of sewers length changes is double that of waterworks. In the whole analyzed period the mean annual length increase amounted do 14% whereas highest values reached over 20% over the years 1995-2003. The similar course of development has been also observed in case of waterworks and their mean annual increase over the whole period amounted to about 6%.

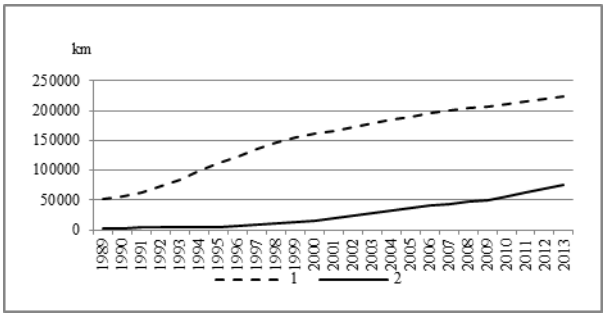

Fig. 1. Length of waterworks and sewers on rural areas in Poland.
Conventions: 1 – water supply network; 2 – sewage network

The development of analyzed infrastructure caused an increase of population percentage served by it. As a result the number of people using sewer systems has increased several-fold. But in the case of waterworks this value has only increased by XX (Table 1).

Table 1. Population share served by waterworks and sewer systems in Poland

	Population using					
	Water supply system			Wastewater treatment		
	1995	2004	2013	1995	2004	2013
Poland	81.2*	85.5	88	41.6	59.0	70.7
Poland - rural areas	61.4*	71.3	76.6	3.1	18.5	35.3

*estimated on the number of water supply connections

Dynamic development of water and sewage infrastructure combined with an increase in rural population has led to a persistent positive trend in terms of consumed water and produced sewage. In the same period from the country perspective the overall tendency was

other way around [4,5]. Its cause is the drop in terms of water demand in cities and by water intensive industrial plants.

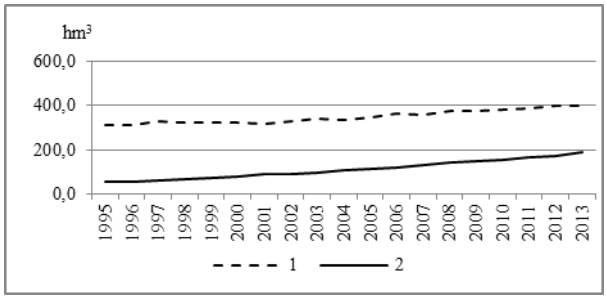

Fig. 2. Water consumption and wastewater discharge in polish household on rural areas
Conventions: 1 – Consumption of water; 2 – Discharged wastewater

The water and sewage infrastructure has also experienced an improvement in terms of quality. In this case a good example is an increase in number and king of wastewater treatment plants. A total number of all wastewater treatment plants have increased by factor of five and a most significant change has been observed in area of biological purification plants capable of removing biogenic contaminants. Mentioned biological plants are of particular importance because they ensure the highest level of hazardous (biogenic contaminants) removal from wastewater.

Table 2. Number of sewage treatment plants by kind and share in sewage treatment

Sewage treatment plants	Number of sewage treatment plants			Share of purified water by kind of plant [%]		
	1995	2004	2013	1995	2004	2013
Mechanical	23	82	39	4.8	2.1	0.6
Chemical	4	-	-	1,0	-	-
Biological	402	1,537	2,014	87.8	58.0	48.8
With increased biogenne removal	22	327	438	6.5	39.9	50.6

The main obstacle restricting the development of sewage system on rural areas which are characterized by dispersed housing is lack of economic justification for such an investment. With a similar frequency appear technical constraints resulting from site specific relief [8]. In such cases one possible solution is to invest in individual wastewater treatment plants. Over the recent years a declining trend is observed in terms of number of septic tanks while opposite in case of individual wastewater treatment plants on rural areas in Poland.

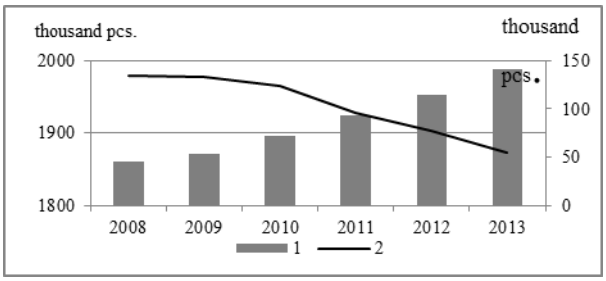

Fig. 3. Number of septic tanks and individual wastewater treatment plants on rural areas in Poland
Conventions: 1 - Independent wastewater treatment facilities; 2 – septic tanks

As has been already mentioned the imposed by EU regulations were the factors which stimulated the intensive development of water and sewage infrastructure. At the same time thanks to the integration with EU in Poland appeared new possibilities to secure financing for the development of this sort of communal infrastructure. Before EU accession rural areas were able to use two so called Pre-Accession Funds: Instrument for Structural Policies for Pre-accession (ISPA) and Support for Pre-accession Measures for Agriculture and Rural Development (SAPARD).

With the accession to the EU new ways of financing water and sewage infrastructure have emerged. Currently one of the tasks of European support funds is to reduce the disproportions in level of communal infrastructure development in rural Ares. This aim is being realized by refinancing local government investments in area of: water supply, sewage discharge and solid waste management [8].

By means of mentioned funds a rapid and complex expansion of individual facilities and elements of water and sewage infrastructure was possible. It is important to underline that the costs of building and modernization of mentioned infrastructure are so high that no individual rural community would be able to realize them by own financial means.

It is worth noting that stated significant development has not appeared in equal measures over the country. A strong

differentiation is visible between number of people served by waterworks and sewers in western and eastern central Poland [3]. The leveling of existing disproportions is essential to ensure sustainable development of the whole country. Because as has been mentioned the water and sewage infrastructure is a key to fast social and economic development.

CONCLUSIONS

The analysis of selected elements of water and sewage infrastructure in Poland indicated meaningful development of their individual parts. Also a disproportion between waterworks and sewers has been pointed out. Despite faster development rates of sewers this aspect of communal infrastructure is still far away behind waterworks. By analyzing individual elements of water and sewage infrastructure before and after accession to the EU it has been observed that the highest dynamic was in pre-accession period. An important role of EU funds without which such a significant progress would not be possible has been stressed out. The development of this kind of communal infrastructure led to an improvement in working conditions of rural population. It has also stipulated the economic development of those areas by raising their investment attractiveness. Thereby importantly limiting the atrophic pressure by reducing the amount of not treated sewage.

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